

WHAT IS CLAIMED IS:

1. An optical disk apparatus comprising:
 - a focusing means for focusing a light beam on a recording medium having first and second information faces;
 - a moving means for moving a focal point of the light beam focused by the focusing means in a direction substantially perpendicular to the information faces of the recording medium;
 - a light detecting means for detecting a reflected light of the focused light beam from the recording medium;
 - a focus condition detecting means for detecting a focus condition of the light beam irradiating the information faces on the basis of an output signal from the light detecting means;
 - a focus control means for driving the moving means on the basis of an output signal from the focus condition detecting means, and controlling the light beam so that the focus condition of the light beam becomes a prescribed focus condition; and
 - a focus jumping means for moving the focal point of the light beam from the first information face to the second information face by driving the moving means;
said focus jumping means comprising:
 - an accelerating means for moving the focal point of the light beam from the first information face to

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the second information face;

a timing signal generating means for generating a timing signal that operates the focus control means on the basis of an output signal from the focus condition detecting means; and

a decelerating means for decelerating the moving speed of the focal point of the light beam in response to a signal from the timing signal generating means.

2. An optical disk apparatus comprising:

a focusing means for focusing a light beam on a recording medium having first and second information faces;

a moving means for moving a focal point of the light beam focused by the focusing means in a direction substantially perpendicular to the information faces of the recording medium;

a light detecting means for detecting a reflected light of the focused light beam from the recording medium;

a focus condition detecting means for detecting a focus condition of the light beam irradiating the information faces on the basis of an output signal from the light detecting means;

a focus control means for driving the moving means on the basis of an output signal from the focus condition

detecting means, and controlling the light beam so that the focus condition of the light beam becomes a prescribed focus condition; and

a focus jumping means for moving the focal point of the light beam from the first information face to the second information face by driving the moving means;

said focus jumping means comprising;

an accelerating means for generating an accelerating signal for moving the focal point of the light beam from one of the first and second information faces of the recording medium to the other information face; and

a decelerating means for decelerating the moving speed of the focal point of the light beam;

wherein, when the recording medium is set horizontally, a product of a peak value and a time interval of the accelerating signal when the focal point of the light beam is moved from the lower information face to the upper information face is larger than a product of a peak value and a time interval of the accelerating signal when the focal point of the light beam is moved from the upper information face to the lower information face.

3. The apparatus of claim 2 wherein the peak value of the accelerating signal when the focal point of the light beam is moved from the lower information face to the upper

information face is larger than the peak value of the accelerating signal when the focal point of the light beam is moved from the upper information face to the lower information face, and the time interval of the accelerating signal is the same for both movements.

4. The apparatus of claim 2 wherein the time interval of the accelerating signal when the focal point of the light beam is moved from the lower information face to the upper information face is longer than the time interval of the accelerating signal when the focal point of the light beam is moved from the upper information face to the lower information face, and the peak value of the accelerating signal is the same for both movements.

5. An optical disk apparatus comprising:
a focusing means for focusing a light beam on a recording medium having first and second information faces;
a moving means for moving a focal point of the light beam focused by the focusing means in a direction substantially perpendicular to the information faces of the recording medium;
a light detecting means for detecting a reflected light of the focused light beam from the recording medium;
a focus condition detecting means for detecting a

focus condition of the light beam irradiating the information faces on the basis of an output signal from the light detecting means;

a focus control means for driving the moving means on the basis of an output signal from the focus condition detecting means, and controlling the light beam so that the focus condition of the light beam becomes a prescribed focus condition; and

a focus jumping means for moving the focal point of the light beam from the first information face to the second information face by driving the moving means;

said focus jumping means comprising;

an accelerating means for generating an accelerating signal for moving the focal point of the light beam from one of the first and second information faces of the recording medium to the other information face; and

a decelerating means for generating a decelerating signal for decelerating the moving speed of the focal point of the light beam;

wherein, when the recording medium is set horizontally, a product of a peak value and a time interval of the decelerating signal when the focal point of the light beam is moved from the lower information face to the upper information face is smaller than a product of a peak value and a time interval of the decelerating signal when the

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focal point of the light beam is moved from the upper information face to the lower information face.

6. The apparatus of claim 5 wherein the peak value of the decelerating signal when the focal point of the light beam is moved from the lower information face to the upper information face is smaller than the peak value of the decelerating signal when the focal point of the light beam is moved from the upper information face to the lower information face, and the time interval of the decelerating signal is the same for both movements.

7. The apparatus of claim 5 wherein the time interval of the decelerating signal when the focal point of the light beam is moved from the lower information face to the upper information face is shorter than the time interval of the decelerating signal when the focal point of the light beam is moved from the upper information face to the lower information face, and the peak value of the decelerating signal is the same for both movements.

8. An optical disk apparatus comprising:
a focusing means for focusing a light beam on a recording medium having first and second information faces;
a moving means for moving a focal point of the

light beam focused by the focusing means in a direction substantially perpendicular to the information faces of the recording medium;

a light detecting means for detecting a reflected light of the focused light beam from the recording medium;

a focus condition detecting means for detecting a focus condition of the light beam irradiating the information faces on the basis of an output signal from the light detecting means;

a focus control means for driving the moving means on the basis of an output signal from the focus condition detecting means, and controlling the light beam so that the focus condition of the light beam becomes a prescribed focus condition; and

a focus jumping means for moving the focal point of the light beam from the first information face to the second information face by driving the moving means;

said focus jumping means comprising;

an accelerating means for generating an accelerating signal for moving the focal point of the light beam from one of the first and second information faces of the recording medium to the other information face; and

a decelerating means for decelerating the moving speed of the focal point of the light beam;

wherein a product of a peak value and a time

interval of the accelerating signal for moving the focal point of the light beam from the lower information face to the upper information face when the recording medium is set horizontally is larger than a product of a peak value and a time interval of the accelerating signal when the recording medium is set vertically.

9. The apparatus of claim 8 wherein the peak value of the accelerating signal for moving the focal point of the light beam from the lower information face to the upper information face when the recording medium is set horizontally is larger than the peak value of the accelerating signal when the recording medium is set vertically, and the time interval of the accelerating signal is the same for both cases.

10. The apparatus of claim 8 wherein the time interval of the accelerating signal for moving the focal point of the light beam from the lower information face to the upper information face when the recording medium is set horizontally is longer than the time interval of the accelerating signal when the recording medium is set vertically, and the peak value of the accelerating signal is the same for both cases.

11. An optical disk apparatus comprising:

a focusing means for focusing a light beam on a recording medium having first and second information faces;

a moving means for moving a focal point of the light beam focused by the focusing means in a direction substantially perpendicular to the information faces of the recording medium;

a light detecting means for detecting a reflected light of the focused light beam from the recording medium;

a focus condition detecting means for detecting a focus condition of the light beam irradiating the information faces on the basis of an output signal from the light detecting means;

a focus control means for driving the moving means on the basis of an output signal from the focus condition detecting means, and controlling the light beam so that the focus condition of the light beam becomes a prescribed focus condition; and

a focus jumping means for moving the focal point of the light beam from the first information face to the second information face by driving the moving means;

said focus jumping means comprising;

an accelerating means for generating an accelerating signal for moving the focal point of the light beam from one of the first and second information faces of

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the recording medium to the other information face; and
a decelerating means for generating a
decelerating signal for decelerating the moving speed of the
focal point of the light beam;

wherein a product of a peak value and a time
interval of the decelerating signal for moving the focal
point of the light beam from the lower information face to
the upper information face when the recording medium is set
horizontally is smaller than a product of a peak value and a
time interval of the decelerating signal when the recording
medium is set vertically.

OBLIQUE RECORDING APPARATUS

12. The apparatus of claim 11 wherein the peak value of
the decelerating signal for moving the focal point of the
light beam from the lower information face to the upper
information face when the recording medium is set
horizontally is smaller than the peak value of the
decelerating signal when the recording medium is set
vertically, and the time interval of the decelerating signal
is the same for both cases.

13. The apparatus of claim 11 wherein the time interval
of the decelerating signal for moving the focal point of the
light beam from the lower information face to the upper
information face when the recording medium is set

horizontally is shorter than the time interval of the decelerating signal when the recording medium is set vertically, and the peak value of the decelerating signal is the same for both cases.

14. An optical disk apparatus comprising:

a focusing means for focusing a light beam on a recording medium having first and second information faces;

a moving means for moving a focal point of the light beam focused by the focusing means in a direction substantially perpendicular to the information faces of the recording medium;

a light detecting means for detecting a reflected light of the focused light beam from the recording medium;

a focus condition detecting means for detecting a focus condition of the light beam irradiating the information faces on the basis of an output signal from the light detecting means;

a focus control means for driving the moving means on the basis of an output signal from the focus condition detecting means, and controlling the light beam so that the focus condition of the light beam becomes a prescribed focus condition; and

a focus jumping means for moving the focal point of the light beam from the first information face to the second

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information face by driving the moving means;
said focus jumping means comprising;
an accelerating means for generating an
accelerating signal for moving the focal point of the light
beam from one of the first and second information faces of
the recording medium to the other information face; and
a decelerating means for decelerating the
moving speed of the focal point of the light beam;
wherein a product of a peak value and a time
interval of the accelerating signal for moving the focal
point of the light beam from the upper information face to
the lower information face when the recording medium is set
horizontally is smaller than a product of a peak value and a
time interval of the accelerating signal when the recording
medium is set vertically.

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15. The apparatus of claim 14 wherein the peak value of
the accelerating signal for moving the focal point of the
light beam from the upper information face to the lower
information face when the recording medium is set
horizontally is smaller than the peak value of the
accelerating signal when the recording medium is set
vertically, and the time interval of the accelerating signal
is the same for both cases.

16. The apparatus of claim 14 wherein the time interval of the accelerating signal for moving the focal point of the light beam from the upper information face to the lower information face when the recording medium is set horizontally is shorter than the time interval of the accelerating signal when the recording medium is set vertically, and the peak value of the accelerating signal is the same for both cases.

OPTICAL DISK RECORDING APPARATUS

17. An optical disk apparatus comprising:
- a focusing means for focusing a light beam on a recording medium having first and second information faces;
 - a moving means for moving a focal point of the light beam focused by the focusing means in a direction substantially perpendicular to the information faces of the recording medium;
 - a light detecting means for detecting a reflected light of the focused light beam from the recording medium;
 - a focus condition detecting means for detecting a focus condition of the light beam irradiating the information faces on the basis of an output signal from the light detecting means;
 - a focus control means for driving the moving means on the basis of an output signal from the focus condition detecting means, and controlling the light beam so that the

focus condition of the light beam becomes a prescribed focus condition; and

a focus jumping means for moving the focal point of the light beam from the first information face to the second information face by driving the moving means;

said focus jumping means comprising;

an accelerating means for generating an accelerating signal for moving the focal point of the light beam from one of the first and second information faces of the recording medium to the other information face; and

a decelerating means for generating a decelerating signal for decelerating the moving speed of the focal point of the light beam;

wherein a product of a peak value and a time interval of the decelerating signal for moving the focal point of the light beam from the upper information face, to the lower information face when the recording medium is set horizontally is larger than a product of a peak value and a time interval of the decelerating signal when the recording medium is set vertically.

18. The apparatus of claim 17 wherein the peak value of the decelerating signal for moving the focal point of the light beam from the upper information face to the lower information face when the recording medium is set

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horizontally is larger than the peak value of the decelerating signal when the recording medium is set vertically, and the time interval of the decelerating signal is the same for both cases.

19. The apparatus of claim 17 wherein the time interval of the decelerating signal for moving the focal point of the light beam from the upper information face to the lower information face when the recording medium is set horizontally is longer than the time interval of the decelerating signal when the recording medium is set vertically, and the peak value of the decelerating signal is the same for both cases.

GOING IN A DIRECTION SUBSTANTIALLY PERPENDICULAR TO THE INFORMATION FACES OF THE RECORDING MEDIUM;

20. An optical disk apparatus comprising:
a focusing means for focusing a light beam on a recording medium having first and second information faces;
a moving means for moving a focal point of the light beam focused by the focusing means in a direction substantially perpendicular to the information faces of the recording medium;
a light detecting means for detecting a reflected light of the focused light beam from the recording medium;
a focus control means for detecting a focus condition of the light beam irradiating the information

faces on the basis of an output signal from the light detecting means, driving the moving means on the basis of the detection signal, and controlling the light beam so that the focus condition of the light beam becomes a prescribed focus condition;

a focus jumping means for moving the focal point of the light beam from the first information face to the second information face by driving the moving means; and

a reflected light amount storage means for storing signals corresponding to the amount of reflected light which are detected by the light detecting means when the focal point of the light beam is passed through the first and second information faces by driving the moving means so that the light beam goes away from or close to the recording medium:

wherein, when a focus jumping is performed by the focus jumping means, a gain of the focus control means is changed according to the values stored in the reflected light amount storage means.

21. The apparatus of claim 20 wherein, when the focus jumping is performed by the focus jumping means, a focus control lead-in level is set according to the values stored in the reflected light amount storage means.

22. The apparatus of claim 20 wherein a focus control lead-in level for the focus jumping is set according to an output signal from the focus control means a gain of which is changed according to the values stored in the reflected light amount storage means.

23. An optical disk apparatus comprising:

a focusing means for focusing a light beam on a recording medium having first and second information faces;

a moving means for moving a focal point of the light beam focused by the focusing means in a direction substantially perpendicular to the information faces of the recording medium;

a light detecting means for detecting a reflected light of the focused light beam from the recording medium;

a focus control means for detecting a focus condition of the light beam irradiating the information faces on the basis of an output signal from the light detecting means, driving the moving means on the basis of the detection signal, and controlling the light beam so that the focus condition of the light beam becomes a prescribed focus condition;

a focus jumping means for moving the focal point of the light beam from the first information face to the second information face by driving the moving means; and

a focus condition detecting signal storage means for storing focus condition detecting signals which are obtained when the focal point of the light beam is passed through the first and second information faces by driving the moving means so that the light beam goes away from or close to the recording medium;

wherein, when a focus jumping is performed by the focus jumping means, a gain of the focus control means is changed according to the values stored in the focus condition detecting signal storage means.

24. The apparatus of claim 23 wherein, when the focus jumping is performed by the focus jumping means, a focus control lead-in level is set according to the values stored in the focus condition detecting signal storage means.

25. The apparatus of claim 23 wherein a focus control lead-in level for the focus jumping is set according to an output signal from the focus control means a gain of which is changed according to the values stored in the focus condition detecting signal storage means.

26. An optical disk apparatus comprising:
a focusing means for focusing a light beam on a recording medium having first and second information faces;

a moving means for moving a focal point of the light beam focused by the focusing means in a direction substantially perpendicular to the information faces of the recording medium;

a light detecting means for detecting a reflected light of the focused light beam from the recording medium;

a reflected light amount detecting means for detecting a signal corresponding to the reflected light amount obtained by the light detecting means;

a focus condition detecting means for detecting a focus condition of the light beam irradiating the information faces, according to an output signal from the light detecting means;

division means for dividing a signal from the focus condition detecting means by a signal from the reflected light amount detecting means; and

a focus jumping means for moving the focal point of the light beam from the first information face to the second information face by driving the moving means on the basis of a signal from the division means.

27. An optical disk apparatus comprising:

a focusing means for focusing a light beam on a recording medium;

a moving means for moving a focal point of the

OPTICAL DISK APPARATUS

light beam focused by the focusing means, in a direction substantially perpendicular to a information face of the recording medium;

a light detecting means having at least two light responsive parts, for detecting a reflected light from the recording medium;

a focus condition detecting means for detecting a focus condition of the light beam irradiating the information face, on the basis of a difference of signals output from the two light responsive regions of the light detecting means;

a focus control means for driving the moving means on the basis of an output signal from the focus condition detecting means, and controlling the light beam so that the focus condition of the light beam becomes a prescribed focus condition; and

a seeking means for moving the light beam in a direction perpendicular to tracks on the recording medium and seeking a desired track;

wherein, when a desired track is sought by the seeking means, said focus condition detecting means detects peak levels of signals output from the two light responsive regions of the light detecting means, and detects a focus condition of the light beam irradiating the information face from a difference of the detected peak level signals.

28. An optical disk apparatus for reproducing information recorded on a recording medium having two information faces, by irradiating the recording medium with a focused light beam, the apparatus comprising:

a moving means for moving a focal point of the light beam irradiating the recording medium so that the focal point crosses a track on the recording medium;

a tracking control means for detecting a positional error between the focal point of the light beam and the track on the recording medium, drives the moving means according to the track error signal, and controls the light beam so that the focal point is positioned on the track;

a focus jumping means for jumping the focal point of the light beam to a target information face, which is one of the first information face and the second information face, and seeking the target information face;

a decentration signal storage means for storing decentration signals corresponding to decentrations of tracks on the first information face and the second information face when the jumping and seeking are performed by the focus jumping means;

an adding means for adding the decentration signals stored in the decentration signal storage means to an output signal from the tracking control means; and

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a system control means for controlling the system so that a decentration signal which is read out of the decentration signal storage means and corresponds to the target information face is added to the tracking control means, when the jumping and seeking are performed by the focus jumping means.

29. An optical disk apparatus for reproducing information recorded on a recording medium having two information faces, by irradiating the recording medium with a focused light beam, the apparatus comprising:

a moving means for moving a focal point of the light beam irradiating the recording medium so that the focal point crosses a track on the recording medium;

a tracking control means for detecting a positional error between the focal point of the light beam and the track on the recording medium, drives the moving means according to the track error signal, and controls the light beam so that the focal point is positioned on the track;

a focus jumping means for jumping the focal point of the light beam to a target information face, which is one of the first information face and the second information face, and seeking the target information face;

a tracking gain storage means for storing desired loop gains of the tracking control means for the first

information face and the second information face, when the jumping and seeking are performed by the focus jumping means;

a multiplication means for multiplying the track gain signals stored in the tracking gain storage means by an output signal from the tracking control means; and

a system control means for controlling the system so that a tracking gain signal which is read out of the tracking gain storage means and corresponds to the target information face is multiplied by the output signal from the tracking control means, when the jumping and seeking are performed by the focus jumping means.

30. An optical disk apparatus for reproducing information recorded on a recording medium having two information faces, by irradiating the recording medium with a focused light beam, the apparatus comprising:

a moving means for moving a focal point of the light beam irradiating the recording medium so that the focal point crosses a track on the recording medium;

a light detecting means for detecting a reflected light from the recording medium;

a focus control means for detecting a focus condition of the light beam irradiating the information faces on the basis of an output signal from the light

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detecting means, driving the moving means on the basis of the detection signal, and controlling the light beam so that the focus condition of the light beam becomes a prescribed focus condition;

a focus jumping means for jumping the focal point of the light beam to a target information face, which is one of the first information face and the second information face, and seeking the target information face;

a focus gain storage means for storing desired loop gains of the focus control means for the first information face and the second information face, when the jumping and seeking are performed by the focus jumping means;

a multiplication means for multiplying the focus gain signals stored in the focus gain storage means by an output signal from the focus control means; and

a system control means for controlling the system so that a focus gain signal which is read out of the focus gain storage means and corresponds to the target information face is multiplied by the output signal from the focus control means, when the jumping and seeking are performed by the focus jumping means.

31. An optical disk apparatus for reproducing information recorded on a recording medium having two information faces, by irradiating the recording medium with

a focused light beam, the apparatus comprising:

a moving means for moving a focal point of the light beam irradiating the recording medium so that the focal point crosses a track on the recording medium;

a light detecting means for detecting a reflected light from the recording medium;

a focus control means for detecting a focus condition of the light beam irradiating the information faces on the basis of an output signal from the light detecting means, driving the moving means on the basis of the detection signal, and controlling the light beam so that the focus condition of the light beam becomes a prescribed focus condition;

a focus jumping means for jumping the focal point of the light beam to a target information face, which is one of the first information face and the second information face, and seeking the target information face;

a focus position storage means for storing desired target positions of the focus control means on the first information face and the second information face when the jumping and seeking are performed by the focus jumping means; and

a system control means for controlling the system so that the target position of the focus control means is changed to a focus position signal that is read out of the

focus position storage means and corresponds to the target information face, when the jumping and seeking are performed by the focus jumping means.

32. An optical disk apparatus for reproducing information recorded on a recording medium having two information faces, by irradiating the recording medium with a focused light beam, the apparatus comprising:

a moving means for moving a focal point of the light beam irradiating the recording medium so that the focal point crosses a track on the recording medium;

a tracking control means for detecting a positional error between the focal point of the light beam and the track on the recording medium, drives the moving means according to the track error signal, and controls the light beam so that the focal point is positioned on the track;

a focus jumping means for jumping the focal point of the light beam to a target information face, which is one of the first information face and the second information face, and seeking the target information face;

a tracking position storage means for storing desired target positions of the tracking control means on the first information face and the second information face, when the jumping and seeking are performed by the focus jumping means; and

a system control means for controlling the system so that the target position of the tracking control means is changed to a tracking position signal which is read out of the tracking position storage means and corresponds to the target information face, when the jumping and seeking are performed by the focus jumping means.

33. An optical disk apparatus comprising:

a focusing means for focusing a light beam on a recording medium having first and second information faces;

a moving means for moving a focal point of the light beam focused by the focusing means in a direction substantially perpendicular to a track on the recording medium;

a light detecting means for detecting a reflected light from the recording medium at a plurality of light responsive parts;

a phase difference track error detecting means for generating a phase difference track error signal corresponding to the positional relationship between the focal point of the light beam and the track on each information face, on the basis of the phase relationship of signals output from the respective light responsive parts of the light detecting means;

a tracking control means for driving the moving

means according to an output signal from the phase difference track error detecting means, and controlling the light beam on the information face so that the focal point of the light beam seeks the track correctly;

a focus jumping means for jumping the focal point of the light beam to a target information face, which is one of the first information face and the second information face, and seeking the target information face;

a phase offset storage means for storing delays or leads of signals output from the respective light responsive parts of the light detecting means, said delays or leads providing desired values for output signals from the phase difference track error detecting means on the first information face and the second information face, when the jumping and seeking are performed by the focus jumping means; and

a system control means for controlling the system so that the delays or leads of the signals from the respective light responsive parts of the light detecting means are changed to a phase offset signal that is read out from the phase offset storage means and corresponds to the target information face when the jumping and seeking are performed by the focus jumping means.

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ABSTRACT OF THE DISCLOSURE

An optical disk apparatus comprises a focusing means for focusing a light beam on a recording medium having first and second information faces; means for moving a focal point of the light beam in a direction substantially perpendicular to the information faces of the recording medium; means for detecting a reflected light from the recording medium; means for detecting a focus condition of the light beam on the basis of an output signal from the reflected light detecting means; a focus control means for driving the focal point moving means on the basis of an output signal from the focus condition detecting means, and controlling the light beam so that the focus condition of the light beam becomes a prescribed focus condition; and a focus jumping means for moving the focal point of the light beam from the first information face to the second information face by driving the focal point moving means. The focus jumping means comprises an accelerating means for moving the focal point of the light beam from the first information face to the second information face; a timing signal generating means for generating a timing signal that operates the focus control means on the basis of an output signal from the focus condition detecting means; and a decelerating means for decelerating the moving speed of the focal point of the light beam in response to a signal from the timing signal generating means.

generating means. In this apparatus, in the focus control holding state, the accelerating signal and the decelerating signal, having opposite polarities, are applied to the light beam moving means, whereby the light beam is moved between two information faces. Further, the light beam's reaching a target information face or going a little over the information face is detected by an output from the light beam focusing condition detecting means, whereby the focus control means is operated. Therefore, in a dual-layer disk or a multiple-layer disk, the focus jumping from one information face to another information face can be performed at high speed, with high reliability.

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